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Totalflow Modbus Protocol for FCU CB181 Version 3

PRODUCT LINE TOTALFLOW®	LEVEL 3	ABB TOTALFLOW Division							
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I. Purpose

This paper describes Modbus communications protocol for Totalflow FCUs.

II. Modbus Description

The Modbus protocol is described in the document entitled "Gould Modbus Protocol Reference Guide" published January, 1985 by Gould Inc., Programmable Control Division, Andover, Massachusetts.

Modbus uses the master, slave communications concept. Slave devices speak only when spoken to by the master. Each slave is identified by an unsigned, one byte number ranging from 1 to 247 (inclusive). A slave must send a single response to a master's request for data.

Modbus messages may be one of two formats:

Modbus RTU message frame format:

Packet	CRC
N x 8 bits	16-bits

Packet: The packet field consists of the Modbus packet being sent or received. Packet format varies with the function being performed and the register group being accessed.

CRC: The error check field consists an 16 bit cyclic redundancy check calculated over the length of the packet field.

Modbus ASCII message frame format:

BOF	Packet	LRC	EOF	Ready
:	2 x Number of bytes in Modbus packet	8-bits	CR	LF

BOF: A colon (:) character is used to indicate beginning of frame.

Packet: The packet field consists of hexadecimal ASCII characters representing the Modbus packet being sent or received. The number of characters is twice the number of bytes in the Modbus packet because each packet byte is converted into two hexadecimal ASCII characters ('0'-'9','A'-'F'.)

LRC: The error check field consists an 8 bit longitudinal redundancy check calculated over the length of the packet field before it is converted to hexadecimal ASCII.

EOF/Ready: A carriage return and line feed are used to delineate end of frame.

Note: *Total message frame length can not exceed 256 bytes.*

III. Totalflow Modbus Implementation

Totalflow Modbus supports RTU or ASCII mode. Support has also been added for long integer, floating point, and archive record registers. Totalflow Modbus supports the following subset of the Gould Modbus defined functions:

Code	Function	Description
01	Read Boolean	Reads group of boolean registers
03	Read Registers	Reads group of 16/32 bit registers
05	Set Single Boolean	Set or clear a boolean register
06	Set Single Register	Set a 16/32 bit register to specified value
16	Set Multiple Register	Set multiple 16/32 bit registers
128-143	Exception Response	Used in FCU response packets to indicate errors in processing function codes 1-16.

Packet formats:

Read Query

Address	Function	Register	Quantity
8-bits	8-bits	16-bits	16-bits

Read Response

Address	Function	Byte Count	Data
8-bits	8-bits	8-bits	N x 8 bits

Set Query

Address	Function	Register	Data
8-bits	8-bits	16-bits	N x 8 bits

Set Response

Address	Function	Register	Data
8-bits	8-bits	16-bits	N x 8 bits

Set Multiple Query

Address	Function	Register	Quantity	Byte Count	Data
8-bits	8-bits	16-bits	16-bits	8-bits	N x 8 bits

Set Multiple Response

Address	Function	Register	Quantity
8-bits	8-bits	16-bits	16-bits

Exception Response

Address	Function	Code
8-bits	8-bits	8-bits

Address: The address field contains the slave address of the FCU intended to receive the packet. Each FCU must be assigned a unique address in the range of 1 to 247.

Function: The function code field contains a code which tells the FCU what to do or what data to send. The high order bit in this field may be set by the FCU in the response packet to indicate an error response.

Register: The register field contains the register number of the FCU data item to fetch or set. For read functions, this is the starting register number.

Code: The code field contains an error value for the exception response. Currently there are three values used; 1 indicates that the function code is unsupported, 2 indicates the register number requested is invalid, 3 indicates that too many data values were requested and that the maximum packet size was exceeded. The maximum packet size for ASCII is 122 bytes and for RTU the maximum packet size is 250.

Quantity: The quantity field contains the number of consecutive registers to fetch or set. This field is not present in all packets (only read and set multiple queries).

Byte Count: The byte count field contains the number of bytes of data being transferred. This field is not present in all packets (only read response and set multiple query).

Data: The data field contains the actual data values being transferred. This field is not present in all packets. The size and format of the data values depend on the register group being accessed. The byte order of data items is high to low (MSB first, LSB last).

IV. Register Group Configuration

Registers are grouped by data type. The grouping is fixed, but the base (or starting) register number of each group is configurable. Default register group assignments:

Default Base	Type	Description
100	INTEGER	Register Configuration Group
200	INTEGER	Custom Integer Configuration
300	FLOATING POINT	Custom Integer Scale Factors
1001	BOOLEAN	1 Bit Boolean Group
3001	INTEGER	16 Bit Integer Group
5001	LONG INTEGER	32 Bit Long Integer Group
7001	FLOATING POINT	32 Bit IEEE Floating Point Group
10001	RECORD	Daily Flow Archive Record Group
11001	RECORD	Log Period Flow Archive Record Group
12001	RECORD	Event Log Archive Record Group
0 (Disabled)	FLOATING POINT	Configurable Read-only Floating Point Group

Group configuration registers are read using function code 03 and set using function code 06 or 16. To disable a register group, set the base register to zero (0).

Register	Access	Description
100	Read/Write	Configuration Group Base Register Number
101	Read/Write	Boolean Register Group Base Register Number
102	Read/Write	Integer Register Group Base Register Number
103	Read/Write	Long Register Group Base Register Number
104	Read/Write	Floating Point Register Group Base Register Number
105	Read/Write	Daily Flow Archive Register Group Base Register Number
106	Read/Write	Log Period Archive Register Group Base Register Number
107	Read/Write	Event Log Archive Register Group Base Register Number
110	Read/Write	Configurable Register Group Base Register Number
111	Read/Write	Configurable Register 1
112	Read/Write	Configurable Register 2
113	Read/Write	Configurable Register 3
114	Read/Write	Configurable Register 4
115	Read/Write	Configurable Register 5
116	Read/Write	Configurable Register 6
117	Read/Write	Configurable Register 7
118	Read/Write	Configurable Register 8
119	Read/Write	Configurable Register 9
120	Read/Write	Configurable Register 10
121	Read/Write	Configurable Register 11
122	Read/Write	Configurable Register 12
123	Read/Write	Configurable Register 13
124	Read/Write	Configurable Register 14
125	Read/Write	Configurable Register 15
126	Read/Write	Configurable Register 16
127	Read/Write	Configurable Register 17
128	Read/Write	Configurable Register 18
129	Read/Write	Configurable Register 19
130	Read/Write	Configurable Register 20
131	Read/Write	Configurable Register 21
132	Read/Write	Configurable Register 22
133	Read/Write	Configurable Register 23

Register	Access	Description
134	Read/Write	Configurable Register 24
135	Read/Write	Configurable Register 25
136	Read/Write	Configurable Register 26
137	Read/Write	Configurable Register 27
138	Read/Write	Configurable Register 28
139	Read/Write	Configurable Register 29
140	Read/Write	Configurable Register 30
141	Read/Write	Configurable Register 31
142	Read/Write	Configurable Register 32
143	Read/Write	Configurable Register 33
144	Read/Write	Configurable Register 34
145	Read/Write	Configurable Register 35
146	Read/Write	Configurable Register 36
147	Read/Write	Configurable Register 37
148	Read/Write	Configurable Register 38
149	Read/Write	Configurable Register 39
150	Read/Write	Configurable Register 40
151	Read/Write	Configurable Register 41
152	Read/Write	Configurable Register 42
153	Read/Write	Configurable Register 43
154	Read/Write	Configurable Register 44
155	Read/Write	Configurable Register 45
156	Read/Write	Configurable Register 46
157	Read/Write	Configurable Register 47
158	Read/Write	Configurable Register 48
159	Read/Write	Configurable Register 49
160	Read/Write	Configurable Register 50
161	Read/Write	Configurable Register 51
162	Read/Write	Configurable Register 52
163	Read/Write	Configurable Register 53
164	Read/Write	Configurable Register 54
165	Read/Write	Configurable Register 55
166	Read/Write	Configurable Register 56
167	Read/Write	Configurable Register 57
168	Read/Write	Configurable Register 58
169	Read/Write	Configurable Register 59
170	Read/Write	Configurable Register 60
171	Read/Write	Configurable Register 61
172	Read/Write	Configurable Register 62

V. Configurable Register Group

Registers 110-172 can be used to configure a custom floating point register group as follows:

- Define the register group by writing the fixed register numbers of the data items to be included in this register group into registers 111-172. Any of the Boolean, Integer, Long Integer, or Floating Point registers may be specified. The data from boolean, integer, and long integer registers will be converted to floating point before they are inserted into the response packet.

- Enable the register group by writing a base register number into register 110. This will be the starting register number of the custom register group.

Example Custom Group Definition:

110 = 8001 (Starting register number of group)
111 = 0 (Null)
112 = 0 (Null)
113 = 7003 (Current AP)
114 = 7004 (Current DP)
115 = 7005 (Current TF)
116 = 7006 (Current Flow Rate)
117 = 7009 (Today's Accumulated Volume)
118 = 7022 (Previous Day's Volume)
119 = 7001 (Current Battery Voltage)
120 = 7002 (Current Charger Voltage)

Using the above group definition, a poll of registers 8001-8010 will return:

8001 = zero (0.0)
8002 = zero (0.0)
8003 = Current AP
8004 = Current DP
8005 = Current TF
8006 = Current Flow Rate
8007 = Today's Accumulated Volume
8008 = Previous Day's Volume
8009 = Current Battery Voltage
8010 = Current Charger Voltage

As shown in the example above, null (0) register entries are allowed. The response packet will be padded with zero (0.0) values for each null register polled. Attempts to write to null register entries will be ignored.

Custom integer configuration allows modbus registers to be scaled and returned as 16 bit integer values. The following table shows the Custom integer configuration table.

Register	Access	Description
200	Read Only	Integer Configuration Group Base Register Number
201	Read/Write	Custom Integer Scale Register Group Base Register Number
202	Read/Write	Configurable Integer Register Group Base Register Number
203	Read/Write	Configurable Register 1
204	Read/Write	Configurable Register 2
205	Read/Write	Configurable Register 3
206	Read/Write	Configurable Register 4
207	Read/Write	Configurable Register 5
208	Read/Write	Configurable Register 6
209	Read/Write	Configurable Register 7
210	Read/Write	Configurable Register 8
211	Read/Write	Configurable Register 9
212	Read/Write	Configurable Register 10
213	Read/Write	Configurable Register 11
214	Read/Write	Configurable Register 12
215	Read/Write	Configurable Register 13
216	Read/Write	Configurable Register 14
217	Read/Write	Configurable Register 15
218	Read/Write	Configurable Register 16
219	Read/Write	Configurable Register 17
220	Read/Write	Configurable Register 18

Register	Access	Description
221	Read/Write	Configurable Register 19
222	Read/Write	Configurable Register 20
223	Read/Write	Configurable Register 21
224	Read/Write	Configurable Register 22
225	Read/Write	Configurable Register 23
226	Read/Write	Configurable Register 24
227	Read/Write	Configurable Register 25
228	Read/Write	Configurable Register 26
229	Read/Write	Configurable Register 27
230	Read/Write	Configurable Register 28
231	Read/Write	Configurable Register 29
232	Read/Write	Configurable Register 30
233	Read/Write	Configurable Register 31
234	Read/Write	Configurable Register 32
235	Read/Write	Configurable Register 33
236	Read/Write	Configurable Register 34
237	Read/Write	Configurable Register 35
238	Read/Write	Configurable Register 36
239	Read/Write	Configurable Register 37
240	Read/Write	Configurable Register 38
241	Read/Write	Configurable Register 39
242	Read/Write	Configurable Register 40
243	Read/Write	Configurable Register 41
244	Read/Write	Configurable Register 42
245	Read/Write	Configurable Register 43
246	Read/Write	Configurable Register 44
247	Read/Write	Configurable Register 45
248	Read/Write	Configurable Register 46
249	Read/Write	Configurable Register 47

Example Custom Integer Group Definition:

202 = 4001 (Starting register number of group)
203 = 7003 (Current AP)
204 = 7004 (Current DP)
205 = 7005 (Current TF)
206 = 7006 (Current Flow Rate)
207 = 7009 (Today's Accumulated Volume)
208 = 7022 (Previous Day's Volume)
209 = 7001 (Current Battery Voltage)
210 = 7002 (Current Charger Voltage)

300 = 100 Scale factor for 4001 Ap
301 = 100 Scale factor for 4002 Dp
302 = 10 Scale factor for 4003 Tf
303 = 1 Scale factor for 4004 Flow Rate
304 = 0.1 Scale factor for 4005 Today's Accumulated Volume
305 = 0.1 Scale factor for 4006 Previous Day's Accumulated Volume
306 = 10 Scale factor for 4007 Battery Voltage
307 = 10 Scale factor for 4008 Charger Voltage

A poll request for registers 4001-4008 using the example configuration above would return the following values.

4001 = Current AP * 100
4002 = Current DP * 100
4003 = Current TF * 10
4004 = Current Flow Rate
4005 = Today's Accumulated Volume *0.1
4006 = Previous Day's Volume * 0.1
4007 = Current Battery Voltage * 10
4008 = Current Charger Voltage * 10

VI. Boolean Register Group

Boolean registers are read using function code 01 or set using function code 05. The base register number for this register group defaults to 1001 when the unit is cold started. It can be changed by setting register 101 to the desired starting register number of the group.

Register	Access	Description	Meter Type
1001	Read/Write	Use Sqrt /linear AP/DP avgs (1 = Sqrt)	Gas Orifice
1002	Read/Write	Use F(pb) (1985 Equation)	G.O. / Turbine
1003	Read/Write	Use F(tb) (1985 Equation)	G.O. / Turbine
1004	Read/Write	Use F(tf) (1985 Equation)	Gas Orifice
1005	Read/Write	Use F(g)(1985 Equation)	Gas Orifice
1006	Read/Write	Use F(a)(1985 Equation)	Gas Orifice
1007	Read/Write	Use F(r) (1985 Equation)	Gas Orifice
1008	Read/Write	Use Y (1985 Equation)	Gas Orifice
1009	Read/Write	Use F(w) (1985 Equation)	Gas Orifice
1010	Read/Write	Use F(pv) (1985 Equation)	Gas Orifice
1011	Read/Write	Use F(aux) (1985 Equation)	G.O. / Turbine
1012	Read/Write	Use F(b)(1985 Equation)	Gas Orifice
1013	Read/Write	Tap location (1985 Equation) (1 = Upstream)	Gas Orifice
1014	Read/Write	Orifice Type (0 = SS, 1 = Monel) (1985 Eq only)	Gas Orifice
1015	Read/Write	Use Y (1992 Equation)	Gas Orifice
1016	Read/Write	Use F(pv) (1992 Equation)	Gas Orifice
1017	Read/Write	Use F(w) (1992 Equation)	Gas Orifice
1018	Read/Write	Use F(aux) (1992 Equation)	Gas Orifice
1019	Read/Write	Tap location (1992 Equation)(1 = Upstream, 0 = Down)	Gas Orifice
1020	Read/Write	Use calc Cd / fixed Cd (1 = calc Cd) (1992 Equation)	Gas Orifice
1021	Read/Write	Tap Type Support (1 = supported) (1985 Equation)	Gas Orifice
1022	Read/Write	Tap type (1 = pipe, 0 = flange) (1985 Equation)	Gas Orifice
1023	Read/Write	RTD installed	G.O. / Turbine
1024	Read/Write	Temperature in calcs (1 = Measured, 0 = Fixed)	G.O. / Turbine
1025	Write Only	Reset volume	Gas Orifice
1026	Write Only	Reset Log Period	Gas Orifice
1027	Read/Write	Trip contact on Low Charger alarm	G.O. / Turbine
1028	Read/Write	Trip contact on DP low alarm	Gas Orifice
1029	Read/Write	Trip contact on DP high alarm	Gas Orifice
1030	Read/Write	Trip contact on AP low alarm	G.O. / Turbine
1031	Read/Write	Trip contact on AP high alarm	G.O. / Turbine
1032	Read/Write	Trip contact on Remote Sense	G.O. / Turbine
1033	Read/Write	Trip contact on volume setpoint	G.O. / Turbine
1034	Read/Write	Aux Contact Auto Reset (1 = yes)	G.O. / Turbine

Register	Access	Description	Meter Type
1035	Read/Write	Auxiliary Contact State (0/1)	Gas Orifice
1036	Read/Write	Hold Current Analog Inputs	Gas Orifice
1037	Read Only	Attached to stream (AIU support)	G.O. / Turbine
1038	Read Only	First analysis received (AIU support)	G.O. / Turbine
1039	Read/Write	Use Fixed Analysis on error (AIU support)	G.O. / Turbine
1040	Read/Write	Use Fixed Water Vapor Content	Gas Orifice
1041	Write Only	Wakeup FCU from low voltage induced sleep	Gas Orifice
1042	Read/Write	Use Fixed Test Mode AP, DP/PI, and RTD values.	Gas Orifice
1043	Read/Write	Use Measured AP	Turbine
1044	Read/Write	Use S (Fpv^2)	Turbine
1045	Read/Write	Trip contact on ACF low alarm	Turbine
1046	Read/Write	Trip contact on ACF high alarm	Turbine
1047	Read Only	Remote Sense Digital Input State(DI 1)	G.O. / Turbine
1048	Read Only	Digital Input 2	G.O. / Turbine
1049	Read/Write	Digital Output 2	G.O. / Turbine
1050	Read/Write	Trip DO1 on TF Low Limit	G.O. / Turbine
1051	Read/Write	Trip DO1 on TF High Limit	G.O. / Turbine
1052	Read/Write	Trip DO1 on Flow Rate Low Limit	G.O. / Turbine
1053	Read/Write	Trip DO1 on Flow Rate HIgh Limit	G.O. / Turbine
1054	Read/Write	Trip DO2 on Low Charger	G.O. / Turbine
1055	Read/Write	Trip DO2 on Dp/ACF Low Limit	G.O. / Turbine
1056	Read/Write	Trip DO2 on Dp/ACF HIgh Limit	G.O. / Turbine
1057	Read/Write	Trip DO2 on Ap Low Limit	G.O. / Turbine
1058	Read/Write	Trip DO2 on Ap HIgh Limit	G.O. / Turbine
1059	Read/Write	Trip DO2 on Remote Sense	G.O. / Turbine
1060	Read/Write	Trip DO2 on Volume Setpoint	G.O. / Turbine
1061	Read/Write	Auto Reset DO2	G.O. / Turbine
1062	Read/Write	Trip DO2 on Tf Low Limit	G.O. / Turbine
1063	Read/Write	Trip DO2 on Tf HIgh Limit	G.O. / Turbine
1064	Read/Write	Trip DO2 on Flow Rate Low Limit	G.O. / Turbine
1065	Read/Write	Trip DO1 on Flow Rate HIgh Limit	G.O. / Turbine
1066	Read/Write	User Bool 0	G.O./ Turbine
1067	Read/Write	User Bool 1	G.O./ Turbine
1068	Read/Write	User Bool 2	G.O./ Turbine
1069	Read/Write	User Bool 3	G.O./ Turbine
1070	Read/Write	User Bool 4	G.O./ Turbine
1071	Read/Write	User Bool 5	G.O./ Turbine
1072	Read/Write	User Bool 6	G.O./ Turbine
1073	Read/Write	User Bool 7	G.O./ Turbine
1074	Read/Write	User Bool 8	G.O./ Turbine
1075	Read/Write	User Bool 9	G.O./ Turbine
1076	Read/Write	User Bool 10	G.O./ Turbine
1077	Read/Write	User Bool 11	G.O./ Turbine
1078	Read/Write	User Bool 12	G.O./ Turbine
1079	Read/Write	User Bool 13	G.O./ Turbine
1080	Read/Write	User Bool 14	G.O./ Turbine
1081	Read/Write	User Bool 15	G.O./ Turbine

Register	Access	Description	Meter Type
1082	Read/Write	User Bool 16	G.O./ Turbine
1083	Read/Write	User Bool 17	G.O./ Turbine
1084	Read/Write	User Bool 18	G.O./ Turbine
1085	Read/Write	User Bool 19	G.O./ Turbine
1086	Read/Write	User Bool 20	G.O./ Turbine
1087	Read/Write	User Bool 21	G.O./ Turbine
1088	Read/Write	User Bool 22	G.O./ Turbine
1089	Read/Write	User Bool 23	G.O./ Turbine
1090	Read/Write	User Bool 24	G.O./ Turbine
1091	Read/Write	User Bool 25	G.O./ Turbine
1092	Read/Write	User Bool 26	G.O./ Turbine
1093	Read/Write	User Bool 27	G.O./ Turbine
1094	Read/Write	User Bool 28	G.O./ Turbine
1095	Read/Write	User Bool 29	G.O./ Turbine
1096	Read/Write	User Bool 30	G.O./ Turbine
1097	Read/Write	User Bool 31	G.O./ Turbine
1098	Read/Write	User Bool 32	G.O./ Turbine
1099	Read/Write	User Bool 33	G.O./ Turbine
1100	Read/Write	User Bool 34	G.O./ Turbine
1101	Read/Write	User Bool 35	G.O./ Turbine
1102	Read/Write	User Bool 36	G.O./ Turbine
1103	Read/Write	User Bool 37	G.O./ Turbine
1104	Read/Write	User Bool 38	G.O./ Turbine
1105	Read/Write	User Bool 39	G.O./ Turbine
1106	Read/Write	User Bool 40	G.O./ Turbine
1107	Read/Write	User Bool 41	G.O./ Turbine
1108	Read/Write	User Bool 42	G.O./ Turbine
1109	Read/Write	User Bool 43	G.O./ Turbine
1110	Read/Write	User Bool 44	G.O./ Turbine
1111	Read/Write	User Bool 45	G.O./ Turbine
1112	Read/Write	User Bool 46	G.O./ Turbine
1113	Read/Write	User Bool 47	G.O./ Turbine
1114	Read/Write	User Bool 48	G.O./ Turbine
1115	Read/Write	User Bool 49	G.O./ Turbine
1116	Read/Write	Live Specific Gravity from AIU or other protocol	G.O./ Turbine
1117	Read/Write	Use fixed Specific Gravity on error	G.O./ Turbine
1118	Read/Write	Live heating value from AIU or other protocol	G.O./ Turbine
1119	Read/Write	Use fixed heating value on error	G.O./ Turbine
1120	Read/Write	Live CO2 mole % from AIU or other protocol	G.O./ Turbine
1121	Read/Write	Use fixed CO2 mole % on error	G.O./ Turbine
1122	Read/Write	Live N2 mole % from AIU or other protocol	G.O./ Turbine
1123	Read/Write	Use fixed N2 mole % on error	G.O./ Turbine
1124	Read/Write	Live methane mole % from AIU or other protocol	G.O./ Turbine
1125	Read/Write	Use fixed methane mole % on error	G.O./ Turbine
1126	Read/Write	Live H2S mole % from AIU or other protocol	G.O./ Turbine
1127	Read/Write	Use fixed H2S mole %on error	G.O./ Turbine
1128	Read/Write	Live H2O mole % from AIU or other protocol	G.O./ Turbine

Register	Access	Description	Meter Type
1129	Read/Write	Use fixed H2O mole % on error	G.O./ Turbine
1130	Read/Write	Live He mole % from AIU or other protocol	G.O./ Turbine
1131	Read/Write	Use fixed He mole % on error	G.O./ Turbine
1132	Read/Write	Live ethane mole % from AIU or other protocol	G.O./ Turbine
1133	Read/Write	Use fixed ethane mole % on error	G.O./ Turbine
1134	Read/Write	Live propane mole % from AIU or other protocol	G.O./ Turbine
1135	Read/Write	Use fixed propane mole % on error	G.O./ Turbine
1136	Read/Write	Live iso-butane mole % from AIU or other protocol	G.O./ Turbine
1137	Read/Write	Use fixed iso-butane mole % on error	G.O./ Turbine
1138	Read/Write	Live n-butane mole % from AIU or other protocol	G.O./ Turbine
1139	Read/Write	Use fixed n-butane mole % on error	G.O./ Turbine
1140	Read/Write	Live iso-pentane mole % from AIU or other protocol	G.O./ Turbine
1141	Read/Write	Use fixed iso-pentane mole % on error	G.O./ Turbine
1142	Read/Write	Live n-pentane mole % from AIU or other protocol	G.O./ Turbine
1143	Read/Write	Use fixed n-pentane mole % on error	G.O./ Turbine
1144	Read/Write	Live n-hexane mole % from AIU or other protocol	G.O./ Turbine
1145	Read/Write	Use fixed n-hexane mole % on error	G.O./ Turbine
1146	Read/Write	Live n-heptane mole % from AIU or other protocol	G.O./ Turbine
1147	Read/Write	Use fixed n-heptane mole % on error	G.O./ Turbine
1148	Read/Write	Live n-octane mole % from AIU or other protocol	G.O./ Turbine
1149	Read/Write	Use fixed n-octane mole % on error	G.O./ Turbine
1150	Read/Write	Live n-nonane mole % from AIU or other protocol	G.O./ Turbine
1151	Read/Write	Use fixed n-nonane mole % on error	G.O./ Turbine
1152	Read/Write	Live n-decane mole % from AIU or other protocol	G.O./ Turbine
1153	Read/Write	Use fixed n-decane mole % on error	G.O./ Turbine
1154	Read/Write	Live oxygen mole % from AIU or other protocol	G.O./ Turbine
1155	Read/Write	Use fixed oxygen mole % on error	G.O./ Turbine
1156	Read/Write	Live carbon monoxide mole % from AIU or other	G.O./ Turbine
1157	Read/Write	Use fixed carbon monoxide mole % on error	G.O./ Turbine
1158	Read/Write	Live hydrogen mole % from AIU or other protocol	G.O./ Turbine
1159	Read/Write	Use fixed hydrogen mole % on error	G.O./ Turbine
1160	Read/Write	Live argon mole % from AIU or other protocol	G.O./ Turbine
1161	Read/Write	Use fixed argon mole % on error	G.O./ Turbine
1162	Read Only	Security switch state	G.O./ Turbine
1163	Read Only	Low Lithium Battery	G.O./ Turbine
1164	Read Only	DI 1 state	G.O./ Turbine
1165	Read Only	DI RTC state	G.O./ Turbine
1166	Read Only	DI 2 state	G.O./ Turbine
1167	Read Only	Low charger	G.O./ Turbine
1168	Read Only	Low battery	G.O./ Turbine
1169	Read Only	Low battery comm level	G.O./ Turbine
1170	Read Only	VCI DI 1	G.O./ Turbine
1171	Read Only	VCI DI 2	G.O./ Turbine
1172	Read Only	VCI DI 3	G.O./ Turbine
1173	Read Only	VCI DI 4	G.O./ Turbine
1174	Read/Write	VCI DO 1	G.O./ Turbine
1175	Read/Write	VCI DO 2	G.O./ Turbine

Register	Access	Description	Meter Type
1176	Read/Write	VCI DO 3	G.O./ Turbine
1177	Read/Write	VCI DO 4	G.O./ Turbine
1178	Read/Write	DO 1	G.O./ Turbine
1179	Read/Write	DO 2	G.O./ Turbine
1180	Read/Write	Remote comm 1 port operate state	G.O./ Turbine
1181	Read/Write	Remote comm2 (aux) operate state	G.O./ Turbine
1182	Read/Write	Remote comm 3 (auxb) operate state	G.O./ Turbine
1183 - 1190	Read/Write	User Bools 1 - 8	G.O./ Turbine
1190 - 1192	Read/Write	User Bools 1 - 2	G.O./ Turbine
1193	Read/Write	Zero pulse and volume accumulators for PI Well Test	G.O.

VII. Short Integer Register Group

Short integer registers are read using function code 03 and set using function code 06 or 16. The base register number for this register group defaults to 3001 when the unit is cold started. It can be changed by setting register 102 to the desired starting register number of the group.

Register	Access	Description	Meter Type
3001	Read Only	Primary element (1 = Turbine, 0 = Gas Orifice)	G.O. / Turbine
3002	Read Only	Primary element mask	G.O. / Turbine
3003	Read/Write	FCU volume calc. method (1 = 1985 eq., 2 = 1992 eq.)	G.O. / Turbine
3004	Read Only	FCU volume calc method mask	G.O. / Turbine
3005	Read Only	FCU calculation units	G.O. / Turbine
3006	Read Only	FCU calculation units mask	G.O. / Turbine
3007	Read/Write	Supercomp method (0 = NX19 Fixed, 1 = NX19 Auto, 2 = NX19 GCN, 3 = NX19 GCNM, 11 = AGA-8 Gross, 12 = AGA-8 Detail)	G.O. / Turbine
3008	Read Only	Supercomp method mask	G.O. / Turbine
3009	Read/Write	Contract Hour	G.O. / Turbine
3010	Read/Write	Volume calculation period in seconds (60, 120, 600, 1200, & 3600)	G.O. / Turbine
3011	Read/Write	Modbus Slave Address	G.O. / Turbine
3012	Read/Write	Remote Comm Baud (0=1200,1=2400,2=4800,3=9600)	G.O. / Turbine
3013	Read/Write	Remote Comm Data Bits (7 or 8)	G.O. / Turbine
3014	Read/Write	Remote Comm Parity (0 = None, 1 = Odd, 2 = Even)	G.O. / Turbine
3015	Read/Write	Remote Comm Stop Bits (1 or 2)	G.O. / Turbine
3016	Read/Write	Radio power up delay(milliseconds)	G.O. / Turbine
3017	Read/Write	Xmitter key delay(milliseconds)	G.O. / Turbine
3018	Read/Write	Xmitter unkey delay (milliseconds)	G.O. / Turbine
3019	Read/Write	Remote Comm Protocol (0 = Totalflow, 1 = Modbus)	G.O. / Turbine
3020	Read/Write	Remote Comm Link Establish Time (Totalflow Protocol)	G.O. / Turbine
3021	Read/Write	Maximum Number of Events	G.O. / Turbine
3022	Read/Write	Sequence Number of Last Event Logged	G.O. / Turbine
3023	Read/Write	Sequence Number of Last Event Read	G.O. / Turbine
3024	Read/Write	Sequence Number of Last Event Acknowledged	G.O. / Turbine
3025	Read/Write	Number of unacknowledged events	G.O. / Turbine
3026	Read/Write	Maximum Number of Log Period Records	G.O. / Turbine
3027	Read Only	Sequence Number of current Log Period Record	G.O. / Turbine
3028	Read/Write	Maximum Number of Day Period Records	G.O. / Turbine

3029	Read Only	Sequence Number of current Day Period Record	G.O. / Turbine
Register	Access	Description	Meter Type
3030	Read Only	Sequence number of 1st Log Period Rec in current day	G.O. / Turbine
3031	Read/Write	Vol Period Counter	G.O. / Turbine
3032	Read/Write	FCU ID	G.O. / Turbine
3033	Read/Write	FCU ID (cont.)	G.O. / Turbine
3034	Read/Write	FCU ID (cont.)	G.O. / Turbine
3035	Read/Write	FCU ID (cont.)	G.O. / Turbine
3036	Read/Write	FCU ID (cont.)	G.O. / Turbine
3037	Read/Write	FCU Location	G.O. / Turbine
3038	Read/Write	FCU Location (cont.)	G.O. / Turbine
3039	Read/Write	FCU Location (cont.)	G.O. / Turbine
3040	Read/Write	FCU Location (cont.)	G.O. / Turbine
3041	Read/Write	FCU Location (cont.)	G.O. / Turbine
3042	Read/Write	FCU Location (cont.)	G.O. / Turbine
3043	Read/Write	FCU Location (cont.)	G.O. / Turbine
3044	Read/Write	FCU Location (cont.)	G.O. / Turbine
3045	Read/Write	FCU Location (cont.)	G.O. / Turbine
3046	Read/Write	FCU Location (cont.)	G.O. / Turbine
3047	Read/Write	FCU Location (cont.)	G.O. / Turbine
3048	Read/Write	FCU Location (cont.)	G.O. / Turbine
3049	Read/Write	Software Part Number	G.O. / Turbine
3050	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3051	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3052	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3053	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3054	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3055	Read/Write	Software Part Name	G.O. / Turbine
3056	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3057	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3058	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3059	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3060	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3061	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3062	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3063	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3064	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3065	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3066	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3067	Read/Write	Software Revision	G.O. / Turbine
3068	Read/Write	Software Revision (cont.)	G.O. / Turbine
3069	Read Only	Flow Window Period In Seconds (1, 2, 5, 10, 15, 20, 30, & 60) (60 - 3600 in 60 sec. intervals)	Turbine
3070	Read/Write	Modbus Group Address	G.O. / Turbine
3071	Read/Write	Current Group Select	G.O. / Turbine
3072	Read/Write	Remote Port Listen Interval Timeout (Seconds)	G.O. / Turbine
3073	Read/Write	Local Port Listen Interval Timeout (Seconds)	G.O. / Turbine
3074	Read/Write	Aux Port Listen Interval Timeout (Seconds)	G.O. / Turbine
3075	Read/Write	Current Analog Input Number (0-6)	G.O. / Turbine
3076-3095	Read/Write	General purpose user registers	G.O. / Turbine
3096	Read/Write	Valve Control Interface Feature Flag Word 1	G.O. / Turbine
3097	Read/Write	Valve Control Interface Feature Flag Word 2	G.O. / Turbine
3098	Read/Write	Valve Control Command Word 1	G.O. / Turbine
3099	Read/Write	Valve Control Command Word 2	G.O. / Turbine
3100	Read/Write	Valve Control Status Word 1	G.O. / Turbine
3101	Read/Write	Valve Control Status Word 2	G.O. / Turbine
3102	Read/Write	Valve Control DP Gain	G.O. / Turbine

Register	Access	Description	Meter Type
3103	Read/Write	Valve Control AP Gain	G.O. / Turbine
3104	Read/Write	Valve Control FR Gain	G.O. / Turbine
3105	Read/Write	Valve Control Command Extension Word	G.O. / Turbine
3106	Read/Write	Valve Control Manual Pulse Width	G.O. / Turbine
3107	Read/Write	Valve Control Calculated Pulse Width	G.O. / Turbine
3108	Read/Write	Valve Control DP Low Override Delay	G.O. / Turbine
3109	Read/Write	Valve Control Intermitter On Duration	G.O. / Turbine
3110	Read/Write	Valve Control Intermitter Off Duration	G.O. / Turbine
3111	Read/Write	Valve Control Intermitter On Remaining	G.O. / Turbine
3112	Read/Write	Valve Control Intermitter Off Remaining	G.O. / Turbine
3113	Read/Write	Valve Control Shut-In Close Duration	G.O. / Turbine
3114	Read/Write	Valve Control Shut-In Close Remaining	G.O. / Turbine
3115	Read/Write	Number of live analysis components	G.O. / Turbine
3116	Read/Write	Live analysis component update period in seconds	G.O. / Turbine
3117	Read/Write	User Int 0	G.O./ Turbine
3118	Read/Write	User Int 1	G.O./ Turbine
3119	Read/Write	User Int 2	G.O./ Turbine
3120	Read/Write	User Int 3	G.O./ Turbine
3121	Read/Write	User Int 4	G.O./ Turbine
3122	Read/Write	User Int 5	G.O./ Turbine
3123	Read/Write	User Int 6	G.O./ Turbine
3124	Read/Write	User Int 7	G.O./ Turbine
3125	Read/Write	User Int 8	G.O./ Turbine
3126	Read/Write	User Int 8	G.O./ Turbine
3127	Read/Write	User Int 10	G.O./ Turbine
3128	Read/Write	User Int 11	G.O./ Turbine
3129	Read/Write	User Int 12	G.O./ Turbine
3130	Read/Write	User Int 13	G.O./ Turbine
3131	Read/Write	User Int 14	G.O./ Turbine
3132	Read/Write	User Int 15	G.O./ Turbine
3133	Read/Write	User Int 16	G.O./ Turbine
3134	Read/Write	User Int 15	G.O./ Turbine
3135	Read/Write	User Int 16	G.O./ Turbine
3136	Read/Write	Remote comm 1 schedule type (0 - always on; 1 - on at a specified hour and minute for n minutes; 2 - on every n hours for n minutes until specified off hour)	G.O./ Turbine
3137	Read/Write	Remote comm 1 schedule hour on	G.O./ Turbine
3138	Read/Write	Remote comm 1 schedule minute on	G.O./ Turbine
3139	Read/Write	Remote comm 1 schedule on duration (minutes)	G.O./ Turbine
3140	Read/Write	Remote comm 1 schedule status (0-off,1-on)	G.O./ Turbine
3141	Read/Write	Remote comm 1 interval for schedule type 2 (hours)	G.O./ Turbine
3142	Read/Write	Remote comm 1 hour off for schedule type 2	G.O./ Turbine
3143	Read/Write	Remote comm 1 exception cryout retry limit during schedule off times	G.O./ Turbine
3144	Read/Write	Remote comm 2 (aux) schedule type (0 - always on; 1 - on at a specified hour and minute for n minutes; 2 - on every n hours for n minutes until specified off hour)	G.O./ Turbine
3145	Read/Write	Remote comm 2 (aux) schedule hour on	G.O./ Turbine
3146	Read/Write	Remote comm 2 (aux) schedule minute on	G.O./ Turbine
3147	Read/Write	Remote comm 2 (aux) schedule on duration (minutes)	G.O./ Turbine
3148	Read/Write	Remote comm 2 (aux) schedule status (0-off,1-on)	G.O./ Turbine
3149	Read/Write	Remote comm 2 (aux) interval for schedule type 2 (hours)	G.O./ Turbine

Register	Access	Description	Meter Type
3150	Read/Write	Remote comm 2 (aux) hour off for schedule type 2	G.O./ Turbine
3151	Read/Write	Remote comm 2 (aux) exception cryout retry limit during schedule off times	G.O./ Turbine
3152	Read/Write	Remote comm 3 (auxb) schedule type (0 - always on; 1 - on at a specified hour and minute for n minutes; 2 - on every n hours for n minutes until specified off hour)	G.O./ Turbine
3153	Read/Write	Remote comm 3 (auxb) schedule hour on	G.O./ Turbine
3154	Read/Write	Remote comm 3 (auxb) schedule minute on	G.O./ Turbine
3155	Read/Write	Remote comm 3 (auxb) schedule on duration (minutes)	G.O./ Turbine
3156	Read/Write	Remote comm 3 (auxb) schedule status (0-off,1-on)	G.O./ Turbine
3157	Read/Write	Remote comm 3 (auxb) interval for schedule type 2 (hours)	G.O./ Turbine
3158	Read/Write	Remote comm 3 (auxb) hour off for schedule type 2	G.O./ Turbine
3159	Read/Write	Remote comm 3 (auxb) exception cryout retry limit during schedule off times	G.O./ Turbine
3160	Read/Write	Integer year - YYYY format	G.O./ Turbine
3161	Read/Write	Integer month, day – MMDD format	G.O./ Turbine
3162	Read/Write	Integer hour, minute – HHMM format	G.O./ Turbine
3163	Read/Write	Remote comm 2 baud rate (0-1200,1-2400,2-4800,3-9600,4-19,200)	G.O./ Turbine
3164	Read/Write	Remote comm 2 data bits	G.O./ Turbine
3165	Read/Write	Remote comm 2 parity (0-none, 1-even, 2-odd)	G.O./ Turbine
3166	Read/Write	Remote comm 2 stop bits (0,1-1, 2-2)	G.O./ Turbine
3167	Read/Write	Remote comm 2 receive power delay (msecs)	G.O./ Turbine
3168	Read/Write	Remote comm 2 transmit key delay (msecs)	G.O./ Turbine
3169	Read/Write	Remote comm 2 transmit unkey delay (msecs)	G.O./ Turbine
3170	Read/Write	Remote comm 2 protocol (0-default, 1-ModbusAscii, 2-TotalflowCCU,3-LCLTerm,4-console,5ModbusRTU,6-SquareD)	G.O./ Turbine
3171	Read/Write	Remote comm 2 link time for Totalflow CCU protocol (0-4 seconds, 1-2 seconds, 2-1 second, 3-0 seconds)	G.O./ Turbine
3172	Read/Write	Remote comm 3 baud rate (0-1200,1-2400,2-4800,3-9600,4-19,200)	G.O./ Turbine
3173	Read/Write	Remote comm 3 data bits	G.O./ Turbine
3174	Read/Write	Remote comm 3 parity (0-none, 1-even, 2-odd)	G.O./ Turbine
3175	Read/Write	Remote comm 3 stop bits (0,1-1, 2-2)	G.O./ Turbine
3176	Read/Write	Remote comm 3 receive power delay (msecs)	G.O./ Turbine
3177	Read/Write	Remote comm 3 transmit key delay (msecs)	G.O./ Turbine
3178	Read/Write	Remote comm 3 transmit unkey delay (msecs)	G.O./ Turbine
3179	Read/Write	Remote comm 3 protocol (0-default, 1-ModbusAscii, 2-TotalflowCCU,3-LCLTerm,4-console,5ModbusRTU,6-SquareD)	G.O./ Turbine
3180	Read/Write	Remote comm 3 link time for Totalflow CCU protocol (0-4 seconds, 1-2 seconds, 2-1 second, 3-0 seconds)	G.O./ Turbine
3181	Read/Write	Remote comm 1 interface type (4-RS232, 12-RS232, 28-RS485, 44-RS485w1AO,56-RS232w4AO,60-RS485w4AO,64-phonemodem)	G.O./ Turbine
3182	Read/Write	Remote comm 2 interface type (4-RS232, 12-RS232, 28-RS485, 44-RS485w1AO,56-RS232w4AO,60-RS485w4AO,64-phonemodem)	G.O./ Turbine
3183	Read/Write	Remote comm 3 interface type (4-RS232, 12-RS232, 28-RS485, 44-RS485w1AO,56-RS232w4AO,60-RS485w4AO,64-phonemodem)	G.O./ Turbine
3184-3203	Read/Write	User Ints 1 – 20	G.O. / Turbine
3204-3223	Read/Write	User Ints 1 – 20	G.O. / Turbine
3224-3233	Read/Write	User Ints 1 - 10	G.O. / Turbine

3234	Read/write	Reset Factory calibration	G.O. / Turbine
Register	Access	Description	Meter Type
3235-3238	Read/Write	User Ints 1 - 4	G.O. / Turbine
3239-3258	Read/Write	User Ints 1 - 20	G.O. / Turbine
3259-3278	Read/Write	User Ints 1 - 20	G.O. / Turbine
3279-3294	Read/Write	User Ints 1 - 16	G.O. / Turbine
3295	Read/Write	Pulse Input 1 flow window (for PI Well Test)	G.O.
3296	Read/Write	Pulse Input 2 flow window (for PI Well Test)	G.O.

VIII. Long Integer Register Group

Long integer registers are read using function code 03 and set using function code 06 or 16. The base register number for this register group defaults to 5001 when the unit is cold started. It can be changed by setting register 103 to the desired starting register number of the group.

Register	Access	Description	Meter Type
5001 / 5001	Read/Write	Date / Time (Julian - # seconds since 00:00:00 1/1/70)	G.O. / Turbine
5002 / 5003	Read/Write	Volume Log period	G.O. / Turbine
5003 / 5005	Read Only	Log Period Counter	G.O. / Turbine
5004 /5007	Read Only	Log Period Start Date/Time	G.O. / Turbine
5005 / 5009	Read Only	Day Period Start Date/Time	G.O. / Turbine
5006 / 5011	Read Only	AIU Date/Time	G.O. / Turbine
5007 / 5013	Read Only	AIU Stream ID	G.O. / Turbine
5008 / 5015	Read/Write	Modbus Security Seed	G.O. / Turbine
5009 / 5017	Read Only	Extended Feature Flags	G.O. / Turbine
5010 / 5019	Read Only	Cold Start Date	G.O. / Turbine
5011 / 5021	Read Only	Total RAM size	G.O. / Turbine
5012 / 5023	Read Only	Total Banked RAM size	G.O. / Turbine
5013 / 5025	Read Only	Total Free Banked RAM	G.O. / Turbine
5014 / 5027	Read Only	Last calc Period Int. Total Seconds	G.O. / Turbine
5015 / 5029	Read Only	Last calc Period Int. Flow Seconds	G.O. / Turbine
5016 / 5031	Read Only	Last calc Period Alarms	G.O. / Turbine
5017 / 5033	Read/Write	PI 1 Accumulated Counts	G.O. / Turbine
5018 / 5035	Read/Write	PI 2 Accumulated Counts	G.O. / Turbine
5019 / 5037	Read Only	PI 1 Current Counts (1 second reading)	G.O. / Turbine
5020 / 5039	Read Only	PI 2 Current Counts (1 second reading)	G.O. / Turbine
5021 / 5041	Read Only	Extended Feature Flags - 2	G.O. / Turbine
5022 – 5049 / 5043 – 5098	Read Only	Zero always	G.O. / Turbine
5050 / 5099	Read/Write	Test PI 1 value	G.O. / Turbine
5051 / 5101	Read/Write	Test PI 2 value	G.O. / Turbine

IX. Floating Point Register Group

Floating point registers are read using function code 03 and set using function code 06 or 16. The base register number for this register group defaults to 7001 when the unit is cold started. It can be changed by setting register 104 to the desired starting register number of the group.

Register	Access	Description	Meter Type
7001 / 7001	Read Only	Current battery voltage	G.O. / Turbine
7002 / 7003	Read Only	Current charger voltage	G.O. / Turbine
7003 / 7005	Read Only	Current AP	G.O. / Turbine
7004 / 7007	Read Only	Current DP	Gas Orifice
7005 / 7009	Read Only	Current Temp	G.O. / Turbine
7006 / 7011	Read Only	Current flow rate (MCF/Hour)	G.O. / Turbine
7007 / 7013	Read Only	Current energy rate (MMBTU/Hour)	G.O. / Turbine
7008 / 7015	Read Only	Accumulated volume (MCF)	G.O. / Turbine
7009 / 7017	Read Only	Accumulated Volume since start of contract day (MCF)	G.O. / Turbine
7010 / 7019	Read Only	Previous Hour diff. pressure	Gas Orifice
7011 / 7021	Read Only	Previous Hour abs. pressure	G.O. / Turbine
7012 / 7023	Read Only	Previous Hour flowing temp	G.O. / Turbine
7013 / 7025	Read Only	Previous Hour extension	Gas Orifice

7014 / 7027	Read Only	Previous Hour volume (MCF)	G.O. / Turbine
Register	Access	Description	Meter Type
7015 / 7029	Read Only	Previous Hour energy (MMBTU)	G.O. / Turbine
7016 / 7031	Read Only	Previous Hour Flow Time (MMMM.SS)	G.O. / Turbine
7017 / 7033	Read Only	Previous Hour Time (MMMM.SS)	G.O. / Turbine
7018 / 7035	Read Only	Previous Day diff. pressure	Gas Orifice
7019 / 7037	Read Only	Previous Day abs. pressure	G.O. / Turbine
7020 / 7039	Read Only	Previous Day flowing temp	G.O. / Turbine
7021 / 7041	Read Only	Previous Day Extension	Gas Orifice
7022 / 7043	Read Only	Previous Day volume (MCF)	G.O. / Turbine
7023 / 7045	Read Only	Previous Day energy (MMBTU)	G.O. / Turbine
7024 / 7047	Read Only	Previous Day Flow Time (MMMM.SS)	G.O. / Turbine
7025 / 7049	Read Only	Previous Day Time (MMMM.SS)	G.O. / Turbine
7026 / 7051	Read/Write	Fixed Analysis BTU	G.O. / Turbine
7027 / 7053	Read/Write	Fixed Analysis Gravity	G.O. / Turbine
7028 / 7055	Read/Write	Fixed Analysis CO2	G.O. / Turbine
7029 / 7057	Read/Write	Fixed Analysis N2	G.O. / Turbine
7030 / 7059	Read/Write	Fixed Analysis Methane	G.O. / Turbine
7031 / 7061	Read/Write	Fixed Analysis Ethane	G.O. / Turbine
7032 / 7063	Read/Write	Fixed Analysis Propane	G.O. / Turbine
7033 / 7065	Read/Write	Fixed Analysis IButane	G.O. / Turbine
7034 / 7067	Read/Write	Fixed Analysis NButane	G.O. / Turbine
7035 / 7069	Read/Write	Fixed Analysis IPentane	G.O. / Turbine
7036 / 7071	Read/Write	Fixed Analysis NPentane	G.O. / Turbine
7037 / 7073	Read/Write	Fixed Analysis NHexane	G.O. / Turbine
7038 / 7075	Read/Write	Fixed Analysis NHeptane	G.O. / Turbine
7039 / 7077	Read/Write	Fixed Analysis NOctane	G.O. / Turbine
7040 / 7079	Read/Write	Fixed Analysis NNonane	G.O. / Turbine
7041 / 7081	Read/Write	Fixed Analysis H2S	G.O. / Turbine
7042 / 7083	Read/Write	Fixed Analysis Hydrogen	G.O. / Turbine
7043 / 7085	Read/Write	Fixed Analysis Helium	G.O. / Turbine
7044 / 7087	Read/Write	Fixed Analysis Oxygen	G.O. / Turbine
7045 / 7089	Read/Write	Fixed Analysis Carbon Monoxide	G.O. / Turbine
7046 / 7091	Read/Write	Fixed Analysis Argon	G.O. / Turbine
7047 / 7093	Read/Write	Fixed Analysis NDecane	G.O. / Turbine
7048 / 7095	Read/Write	Fixed Analysis H2O	G.O. / Turbine
7049 / 7097	Read/Write	Fixed temperature	G.O. / Turbine
7050 / 7099	Read/Write	Temperature bias	G.O. / Turbine
7051 / 7101	Read/Write	Temperature base	G.O. / Turbine
7052 / 7103	Read/Write	Pressure base	G.O. / Turbine
7053 / 7105	Read/Write	Ratio of specific heats	G.O. / Turbine
7054 / 7107	Read/Write	Viscosity	G.O. / Turbine
7055 / 7109	Read/Write	Fixed F(b) (1985 Equation)	Gas Orifice
7056 / 7111	Read/Write	Fixed Cd (1992 Equation)	Gas Orifice
7057 / 7113	Read/Write	Fixed F(aux)	G.O. / Turbine
7058 / 7115	Read/Write	Fixed F(t) for NX19	G.O. / Turbine
7059 / 7117	Read/Write	Fixed F(p) for NX19	G.O. / Turbine
7060 / 7119	Read/Write	Zba - Z of air at base (1992 Equation)	Gas Orifice
7061 / 7121	Read/Write	Orifice diameter	Gas Orifice
7062 / 7123	Read/Write	Orifice plate coef. of expansion (1992 Equation)	Gas Orifice
7063 / 7125	Read/Write	Pipe diameter	Gas Orifice
7064 / 7127	Read/Write	Pipe coef. of expansion (1992 Equation)	Gas Orifice
7065 / 7129	Read/Write	Fixed barometric pressure	G.O. / Turbine
7066 / 7131	Read/Write	Fixed Water Vapor Content (LBS/MMSCF)	Gas Orifice
7067 / 7133	Read/Write	Water Content Bias (LBS/MMSCF)	Gas Orifice
7068 / 7135	Read Only	Last Calc Period diff. pressure	Gas Orifice
7069 / 7137	Read Only	Last Calc Period abs. pressure	G.O. / Turbine

7070 / 7139	Read Only	Last Calc Period flowing temp	G.O. / Turbine
7071 / 7141	Read Only	Last Calc Period volume (MCF)	G.O. / Turbine
Register	Access	Description	Meter Type
7072 / 7143	Read Only	Last Calc Period Extension	Gas Orifice
7073 / 7145	Read Only	Last Calc Period C'	G.O. / Turbine
7074 / 7147	Read Only	Last Calc Period Y	Gas Orifice
7075 / 7149	Read Only	Last Calc Period F(pv)	Gas Orifice
7076 / 7151	Read Only	Last Calc Period F(w)	Gas Orifice
7077 / 7153	Read Only	Last Calc Period F(aux)	Gas Orifice
7078 / 7155	Read Only	Last Calc Period Qv	Gas Orifice
7079 / 7157	Read Only	Last Calc Period F(b)	Gas Orifice
7080 / 7159	Read Only	Last Calc Period F(r)	Gas Orifice
7081 / 7161	Read Only	Last Calc Period F(pb)	G.O. / Turbine
7082 / 7163	Read Only	Last Calc Period F(tb)	G.O. / Turbine
7083 / 7165	Read Only	Last Calc Period F(tf)	Gas Orifice
7084 / 7167	Read Only	Last Calc Period F(g)	Gas Orifice
7085 / 7169	Read Only	Last Calc Period F(a)	Gas Orifice
7086 / 7171	Read Only	Last Calc Period Fip	Gas Orifice
7087 / 7173	Read Only	Last Calc Period Ev	Gas Orifice
7088 / 7175	Read Only	Last Calc Period Orif Diameter	Gas Orifice
7089 / 7177	Read Only	Last Calc Period Pipe Diameter	Gas Orifice
7090 / 7179	Read Only	Last Calc Period Rhob	Gas Orifice
7091 / 7181	Read Only	Last Calc Period qm	Gas Orifice
7092 / 7183	Read Only	Last Calc Period Cd	Gas Orifice
7093 / 7185	Read Only	Last Calc Analysis BTU	G.O. / Turbine
7094 / 7187	Read Only	Last Calc Analysis Gravity	G.O. / Turbine
7095 / 7189	Read Only	Last Calc Analysis CO2	G.O. / Turbine
7096 / 7191	Read Only	Last Calc Analysis N2	G.O. / Turbine
7097 / 7193	Read Only	Last Calc Analysis Methane	G.O. / Turbine
7098 / 7195	Read Only	Last Calc Analysis Ethane	G.O. / Turbine
7099 / 7197	Read Only	Last Calc Analysis Propane	G.O. / Turbine
7100 / 7199	Read Only	Last Calc Analysis IButane	G.O. / Turbine
7101 / 7201	Read Only	Last Calc Analysis NButane	G.O. / Turbine
7102 / 7203	Read Only	Last Calc Analysis IPentane	G.O. / Turbine
7103 / 7205	Read Only	Last Calc Analysis NPentane	G.O. / Turbine
7104 / 7207	Read Only	Last Calc Analysis NHexane	G.O. / Turbine
7105 / 7209	Read Only	Last Calc Analysis NHeptane	G.O. / Turbine
7106 / 7211	Read Only	Last Calc Analysis NOctane	G.O. / Turbine
7107 / 7213	Read Only	Last Calc Analysis NNonane	G.O. / Turbine
7108 / 7215	Read Only	Last Calc Analysis H2S	G.O. / Turbine
7109 / 7217	Read Only	Last Calc Analysis Hydrogen	G.O. / Turbine
7110 / 7219	Read Only	Last Calc Analysis Helium	G.O. / Turbine
7111 / 7221	Read Only	Last Calc Analysis Oxygen	G.O. / Turbine
7112 / 7223	Read Only	Last Calc Analysis Carbon Monoxide	G.O. / Turbine
7113 / 7225	Read Only	Last Calc Analysis Argon	G.O. / Turbine
7114 / 7227	Read Only	Last Calc Analysis NDecane	G.O. / Turbine
7115 / 7229	Read Only	Last Calc Analysis H2O	G.O. / Turbine
7116 / 7231	Read/Write	DP Zero cutoff	Gas Orifice
7117 / 7233	Read/Write	DP low limit	Gas Orifice
7118 / 7235	Read/Write	DP hi limit	Gas Orifice
7119 / 7237	Read/Write	AP lo limit	G.O. / Turbine
7120 / 7239	Read/Write	AP hi limit	G.O. / Turbine
7121 / 7241	Read/Write	Tf low limit	G.O. / Turbine
7122 / 7243	Read/Write	Tf high limit	G.O. / Turbine
7123 / 7245	Read/Write	Flow Rate low limit	G.O. / Turbine
7124 / 7247	Read/Write	Flow Rate high limit	G.O. / Turbine
7125 / 7249	Read/Write	Volume Set Point for contact	G.O. / Turbine

Register	Access	Description	Meter Type
7126 / 7251	Read Only	Accumulated Volume Rollover Setpoint	G.O. / Turbine
7127 / 7253	Read/Write	Places User Site Code in Event Log	G.O. / Turbine
7128 / 7255	Read Only	AP low calibration	G.O. / Turbine
7129 / 7257	Read Only	AP mid calibration	G.O. / Turbine
7130 / 7259	Read Only	AP high calibration	G.O. / Turbine
7131 / 7261	Read Only	DP lo calibration	Gas Orifice
7132 / 7263	Read Only	DP mid calibration	Gas Orifice
7133 / 7265	Read Only	DP high calibration	Gas Orifice
7134 / 7267	Read Only	Current Unfiltered Temp	G.O. / Turbine
7135 / 7269	Read Only	Current Unfiltered AP	G.O. / Turbine
7136 / 7271	Read Only	Current Unfiltered DP	Gas Orifice
7137 / 7273	Read Only	Current Pulse Count * Meter Factor	G.O. / Turbine
7138 / 7275	Read Only	Test Mode Fixed RTD Input Value	G.O. / Turbine
7139 / 7277	Read Only	Test Mode Fixed AP Input Value	G.O. / Turbine
7140 / 7279	Read Only	Test Mode Fixed DP/PI Input Value	G.O. / Turbine
7141 / 7281	Read Only	Previous Vol Period Pulse Count	Turbine
7142 / 7283	Read Only	Current Uncorrected Flow Rate	Turbine
7143 / 7285	Read Only	Uncorrected Accumulated Volume	Turbine
7144 / 7287	Read Only	Yesterday's Uncorrected Volume	Turbine
7145 / 7289	Read Only	Last Calc Period Uncorrected Volume	Turbine
7146 / 7291	Read Only	Last Calc Period S (Fpv^2)	Turbine
7147 / 7293	Read Only	Fixed AP	Turbine
7148 / 7295	Read Only	ACF high limit	Turbine
7149 / 7297	Read Only	ACF low limit	Turbine
7150 / 7299	Read Only	Meter Factor	Turbine
7151 / 7301	Read Only	Accumulated Energy	(G.O. / Turbine)
7152 / 7303	Read Only	Contract Day Accumulated Energy	(G.O. / Turbine)
7153 / 7305	Read Only	Prev Contract Day Accum Energy	(G.O. / Turbine)
7154 / 7307	Read Only	Prev Contract Day Accum Volume	(G.O. / Turbine)
7155 / 7309	Read Only	AI 1 scaled value	(G.O. / Turbine)
7156 / 7311	Read Only	AI 2 scaled value	(G.O. / Turbine)
7157 / 7313	Read Only	AI 1 ratio value	(G.O. / Turbine)
7158 / 7315	Read Only	AI 2 ratio value	(G.O. / Turbine)
7159 / 7317	Read/Write	PI 1 K factor	(G.O. / Turbine)
7160 / 7319	Read/Write	PI 2 K factor	(G.O. / Turbine)
7161 / 7321	Read Only	PI 1 Accum Conract Day Value	(G.O. / Turbine)
7162 / 7323	Read Only	PI 2 Accum Contract Day Value	(G.O. / Turbine)
7163 / 7325	Read Only	PI 1 Prev Contract Day Value	(G.O. / Turbine)
7164 / 7327	Read Only	PI 2 Prev Contract Day Value	(G.O. / Turbine)
7165 / 7329	Read Only	Current PI 1 Value	(G.O. / Turbine)
7166 / 7331	Read Only	Current PI 2 Value	(G.O. / Turbine)
7167 / 7333	Read/Write	Calibrate selected analog input	(G.O. / Turbine)
7168 / 7335	Read/Write	Selected analog input mid hi cal units	(G.O. / Turbine)
7169 / 7337	Read/Write	Selected analog input mid lo cal units	(G.O. / Turbine)
7170 / 7339	Read/Write	Selected analog input high cal units	(G.O. / Turbine)
7171 / 7341	Read/Write	Selected analog input mid cal units	(G.O. / Turbine)
7172 / 7343	Read/Write	Selected analog input low cal units	(G.O. / Turbine)
7173 / 7345	Read/Write	Selected analog input low cal units	(G.O. / Turbine)
7174-7223 / 7347-7445	Read/Write	General purpose user registers 1 - 50	(G.O. / Turbine)
7224 / 7447	Read/Write	Valve Control AP Bias	(G.O. / Turbine)
7225 / 7449	Read/Write	Valve Control DP High	(G.O. / Turbine)
7226 / 7451	Read/Write	Valve Control DP Low	(G.O. / Turbine)
7227 / 7453	Read/Write	Valve Control DP Setpoint	(G.O. / Turbine)
7228 / 7455	Read/Write	Valve Control DP Dead Band	(G.O. / Turbine)

Register	Access	Description	Meter Type
7229 / 7457	Read/Write	Valve Control Pipe Length	(G.O. / Turbine)
7230 / 7459	Read/Write	Valve Control AP High	(G.O. / Turbine)
7231 / 7461	Read/Write	Valve Control AP Low	(G.O. / Turbine)
7232 / 7463	Read/Write	Valve Control AP Setpoint	(G.O. / Turbine)
7233 / 7465	Read/Write	Valve Control AP Dead Band	(G.O. / Turbine)
7234 / 7467	Read/Write	Valve Control Pipe ID	(G.O. / Turbine)
7235 / 7469	Read/Write	Valve Control FR High	(G.O. / Turbine)
7236 / 7471	Read/Write	Valve Control FR Low	(G.O. / Turbine)
7237 / 7473	Read/Write	Valve Control FR Setpoint	(G.O. / Turbine)
7238 / 7475	Read/Write	Valve Control FR Dead Band	(G.O. / Turbine)
7239 / 7477	Read/Write	Valve Control Battery Voltage	(G.O. / Turbine)
7240 / 7479	Read/Write	Valve Control AP Override	(G.O. / Turbine)
7241 / 7481	Read/Write	Valve Control AP Restart	(G.O. / Turbine)
7242 / 7483	Read/Write	Live Analysis Gravity	G.O. / Turbine
7243 / 7485	Read/Write	Live Analysis BTU	G.O. / Turbine
7244 / 7487	Read/Write	Live Analysis CO2	G.O. / Turbine
7245 / 7489	Read/Write	Live Analysis N2	G.O. / Turbine
7246 / 7491	Read/Write	Live Analysis Methane	G.O. / Turbine
7247 / 7493	Read/Write	Live Analysis H2S	G.O. / Turbine
7248 / 7495	Read/Write	Live Analysis H2O	G.O. / Turbine
7249 / 7497	Read/Write	Live Analysis Helium	G.O. / Turbine
7250 / 7499	Read/Write	Live Analysis Ethane	G.O. / Turbine
7251 / 7501	Read/Write	Live Analysis Propane	G.O. / Turbine
7252 / 7503	Read/Write	Live Analysis IButane	G.O. / Turbine
7253 / 7505	Read/Write	Live Analysis NButane	G.O. / Turbine
7254 / 7507	Read/Write	Live Analysis IPentane	G.O. / Turbine
7255 / 7509	Read/Write	Live Analysis NPentane	G.O. / Turbine
7256 / 7511	Read/Write	Live Analysis NHexane	G.O. / Turbine
7257 / 7513	Read/Write	Live Analysis NHeptane	G.O. / Turbine
7258 / 7515	Read/Write	Live Analysis NOctane	G.O. / Turbine
7259 / 7517	Read/Write	Live Analysis NNonane	G.O. / Turbine
7260 / 7519	Read/Write	Live Analysis NDecane	G.O. / Turbine
7261 / 7521	Read/Write	Live Analysis Oxygen	G.O. / Turbine
7262 / 7523	Read/Write	Live Analysis Carbon Monoxide	G.O. / Turbine
7263 / 7525	Read/Write	Live Analysis Hydrogen	G.O. / Turbine
7264 / 7527	Read/Write	Live Analysis Argon	G.O. / Turbine
7265 / 7529	Read/Write	Custom group scale factor	G.O. / Turbine
7266 / 7531	Read/Write	Current flow rate in MCF/Day	G.O. / Turbine
7267 / 7533 – 7316 / 7631	Read/Write	User Floats 1 - 50	G.O. / Turbine
7317 / 7633 –7333 / 7665	Read/Write	User Floats 1 - 17	G.O. / Turbine
7334 / 7667 – 7376 / 7751	Read/Write	User Floats 1 - 43	G.O. / Turbine
7377 / 7753	Read	Static Pressure PSIG	G.O / Turbine
7378 / 7755	Read	Vol Calc Period Average Static Pressure PSIG	G.O. / Turbine
7379 – 7381 / 7757 – 7761	Read/Write	User Floats 1 – 3	G.O. / Turbine
7382 / 7763 – 7386 / 7771	Read/Write	User Floats 1 - 5	G.O. Turbine

Register	Access	Description	Meter Type
7387 / 7773 – 7388 / 7775	Read/Write	User Floats 1 - 2	G.O. / Turbine
7389 / 7777	Read/Write	User Float 1	G.O. / Turbine
7390 / 7779 – 7418 / 7835	Read/Write	User Floats 1 - 29	G.O. / Turbine
7419 / 7837	Read	PI 1 value/window (Pulse * k) / window seconds	G.O. / Turbine
7420 / 7839	Read	PI 2 value/window (Pulse * k) / window seconds	G.O. / Turbine
7421 / 7841	Read	PI 1 accumulated value at last reset	G.O. / Turbine
7422 / 7843	Read	PI 2 accumulated value at last reset	G.O. / Turbine
7423 / 7845	Read	Accumulated volume at last reset	G.O. / Turbine
7424 / 7847	Read/Write	PI 1 k factor (well test)	G.O.
7425 / 7849	Read/Write	PI 2 k factor (well test)	G.O.
7426 / 7851	Read/Write	PI 1 accumulated value (well test)	G.O.
7427 / 7853	Read/Write	PI 2 accumulated value (well test)	G.O.
7428 / 7855	Read	Month accumulated volume	G.O. / Turbine
7429 / 7857	Read	Month accumulated volume Not resettable by command	G.O. / Turbine
7430 / 7859	Read	Previous Month accumulated volume	G.O. / Turbine
7431 / 7861	Read	Previous Month accumulated volume Not resettable by command	G.O. / Turbine
7432 / 7863	Read	Month accumulated energy	G.O. / Turbine
7433 / 7865	Read	Month accumulated energy Not resettable by command	G.O. / Turbine
7434 / 7867	Read	Previous Month accumulated energy	G.O. / Turbine
7435 / 7869	Read	Previous Month accumulated energy Not resettable by command	G.O. / Turbine

X. Log Period Flow Record Register Group

Totalflow Log Period flow records are read using Modbus function code 03. The byte order of the record is reversed in the response packet (MSB of last field first, LSB of first field last.) The base register number for the Log Period Flow Record register group defaults to 11001 when the unit is cold started. It can be changed by setting register 106 to the desired starting register number of the group. Register 11001 accesses the most recent log period record, register 11970 accesses the least recent log period record.

Gas Orifice Log Period Flow Record Format

Field	Size	Type	Description
Date/time	4	ULONG	Log Date/Time (# seconds since 00:00:00 1/1/70)
Sequence #	2	UINT	Log Period record sequence number
Average DP	4	FLOAT	Average differential pressure during flow
Average AP	4	FLOAT	Average static pressure during flow
Average TF	4	FLOAT	Average temperature
Extension	4	FLOAT	Accumulated Extension / 3600
Volume	4	FLOAT	Total volume for the day (MCF)
Energy	4	FLOAT	Total energy for the day
Flowtime	4	ULONG	Total flow seconds for the day
Period time	4	ULONG	Total seconds actually used in this log period
Alarms	3	24BITS	Period alarm summary (See alarm bit mapping)
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

Turbine Log Period Flow Record Format

Field	Size	Type	Description
Date/time	4	ULONG	Log Date/Time (# seconds since 00:00:00 1/1/70)
Sequence #	2	UINT	Log Period record sequence number
Pulse Count	4	FLOAT	Total pulse count for the period
Average AP	4	FLOAT	Average static pressure during flow
Average TF	4	FLOAT	Average temperature
Uncorrected Volume	4	FLOAT	Total uncorrected volume for the day (MACF)
Volume	4	FLOAT	Total volume for the day (MCF)
Energy	4	FLOAT	Total energy for the day
Flowtime	4	ULONG	Total flow seconds for the day
Period time	4	ULONG	Total seconds actually used in this log period
Alarms	3	24BITS	Period alarm summary (See alarm bit mapping)
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

XI. Daily Flow Record Register Group

Totalflow Daily flow records are read using Modbus function code 03. The byte order of the record is reversed in the response packet (MSB of last field first, LSB of first field last.) The base register number for the Daily Flow Record register group defaults to 10001 when the unit is cold started. It can be changed by setting register 105 to the desired starting register number of the group. Register 10001 accesses the most recent daily record, register 10050 accesses the least recent daily record.

Gas Orifice Daily Flow Record Format

Field	Size	Type	Description
Date/time	4	ULONG	Day Date/Time (# seconds since 00:00:00 1/1/70)
Sequence #	2	UINT	Daily record sequence number
Event Sequence #	2	UINT	Event sequence counter at start of day
Starting Log Seq#	2	UINT	1st Log Period record assigned to this day
Ending Log Seq#	2	UINT	Last Log Period record assigned to this day
Contract Hour	1	UCHAR	Start of gas day per contract
Extension	4	FLOAT	Accumulated Extension / 3600
Volume	4	FLOAT	Total volume for the day (MCF)
Energy	4	FLOAT	Total energy for the day
Flowtime	4	ULONG	Total flow seconds for the day
Backflow	4	ULONG	Total backflow seconds for the day
Period time	4	ULONG	Total seconds actually used in this log period
Alarms	3	24BITS	Daily alarm summary (See alarm bit mapping)
Average AP	4	FLOAT	Average static pressure during flow
Min AP	4	FLOAT	Minimum AP value observed during this period
Max AP	4	FLOAT	Maximum AP value observed during this period
% time AP high	4	FLOAT	AP percent of day above hi limit
% time AP low	4	FLOAT	AP percent of day below lo limit
Average DP	4	FLOAT	Average differential pressure during flow
Min DP	4	FLOAT	Minimum DP value observed during this period
Max DP	4	FLOAT	Maximum DP value observed during this period
% time DP high	4	FLOAT	DP percent of day above hi limit
% time DP low	4	FLOAT	DP percent of day below lo limit
Average TF	4	FLOAT	Average temperature
Min TF	4	FLOAT	Minimum Temp value observed during this period
Max TF	4	FLOAT	MaximumTemp value observed during this period
% time TF high	4	FLOAT	Tf percent of day above hi limit
% time TF low	4	FLOAT	Tf percent of day below low limit
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

Turbine Daily Flow Record Format

Field	Size	Type	Description
Date/time	4	ULONG	Day Date/Time (# seconds since 00:00:00 1/1/70)
Sequence #	2	UINT	Daily record sequence number
Event Sequence #	2	UINT	Event sequence counter at start of day
Starting Log Seq#	2	UINT	1st Log Period record assigned to this day
Ending Log Seq#	2	UINT	Last Log Period record assigned to this day
Contract Hour	1	UCHAR	Start of gas day per contract
Uncorrected Volume	4	FLOAT	Total uncorrected volume for the day (MACF)
Volume	4	FLOAT	Total volume for the day (MCF)
Energy	4	FLOAT	Total energy for the day
Flowtime	4	ULONG	Total flow seconds for the day
Backflow	4	ULONG	Total backflow seconds for the day
Period time	4	ULONG	Total seconds actually used in this log period
Alarms	3	24BITS	Daily alarm summary (See alarm bit mapping)
Average AP	4	FLOAT	Average static pressure during flow
Min AP	4	FLOAT	Minimum AP value observed during this period
Max AP	4	FLOAT	Maximum AP value observed during this period
% time AP high	4	FLOAT	AP percent of day above hi limit
% time AP low	4	FLOAT	AP percent of day below lo limit
Pulse Count	4	FLOAT	Total pulse count for the day
Min Pulse Count	4	FLOAT	Minimum pulse count observed during this period
Max Pulse Count	4	FLOAT	Maximum pulse count observed during this period
% time ACF high	4	FLOAT	ACF percent of day above hi limit
% time ACF low	4	FLOAT	ACF percent of day below lo limit
Average TF	4	FLOAT	Average temperature
Min TF	4	FLOAT	Minimum Temp value observed during this period
Max TF	4	FLOAT	Maximum Temp value observed during this period
% time TF high	4	FLOAT	Tf percent of day above hi limit
% time TF low	4	FLOAT	Tf percent of day below low limit
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

XII. Alarm bit mapping for Totalflow Daily and Log Period records

Bit	Description
0	AGA Calculation error
1	Methane gravity method f(pv) used
2	Alternate analysis used
3	Low lithium battery
4	Low charger
5	DP measurement error
6	AP measurement error
7	Temperature measurement error
8	Auxiliary contact #1 tripped
9	Remote sense #1 detected
10	Back flow detected
11	Zero flow detected
12	DP below low limit
13	DP over high limit
14	AP below low limit
15	AP over high limit
16	Tf below low limit
17	Tf above high limit
18	Flow rate below low limit
19	Flow rate above high limit

XIII. Event Log Record Register Group

Totalflow Event records are read using Modbus function code 03. The base register number for this register group defaults to 12001 when the unit is cold started. It can be changed by setting register 107 to the desired starting register number of the group. Register 12001 accesses the most recent event log record, register 12200 accesses the least recent event log record. The byte order of the record is reversed in the response packet (MSB of last field first, LSB of first field last.)

Field	Size	Type	Description
Date/time	4	ULONG	# of seconds since 00:00:00 1/1/70
Event flags	1	BITS	Event flags (such as day skip)
Event Sequence #	2	UINT	Sequence # of event
Event Code	2	UINT	Describes event type (Table 5.13)
Old Value	4	Depends on Code	Value changed from...
New Value	4	Depends on Code	Value changed to...
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

Totalflow Event data types

Type	Old Value Format	New Value Format
1	Unsigned Integer	Unsigned Integer
2	Unsigned Char	Unsigned Char
3	BOOL	BOOL
4	IEEE Floating Point	N/A (Rollover)
5	IEEE Floating Point	IEEE Floating Point
8	Unsigned Long Integer	Unsigned Long Integer
9	2 Character String	2 Character String

Totalflow Event Codes

Event Code	Data Type	Description
1	8	New date and time
5	1	Contract day starting hour
8	8	AIU Stream ID
9	3	Use fixed analysis on error?
10	2	Reset volume
11	2	Wakeup from sleep
12	2	Go to sleep
13	2	Watchdog timeout
14	2	Accumulated volume rollover
15	2	Security code changed
16	3	Attached to AIU stream?
19	3	Is AP present?
20	3	RTD installed
21	3	Use fixed temperature
24	3	SS/Monel orifice plate
25	3	Use Fb
26	3	Use Fr
27	3	Use Y
28	3	Use Ftb
29	3	Use Fpb
30	3	Use Ftf
31	3	Use Fg
32	3	Use Fpv
33	3	Use Fa
34	3	Use contact on charger low
35	3	Contact on dp lo

Event Code	Data Type	Description
36	3	Contact on dp hi
37	3	Contact on ap lo
38	3	Contact on ap hi
39	3	Contact on remote sense
40	3	Auto re-open
41	3	Contact on vol set point
42	3	Use Fw
43	3	Use Faux
44	3	Use Fpm (TURBINE_REV)
45	3	Use Ftm (TURBINE_REV)
46	3	Use s (TURBINE_REV)
47	3	Use Faux (TURBINE_REV)
49	5	fixed ap value (TURBINE_REV)
50	4	well log code (Site Code)
51	4	Accumulated volume reset
52	3	RTD installed (TURBINE)
53	3	Use rtd (TURBINE)
54	3	Auto start TEG (TURBINE)
55	3	Check security code(TURBINE)
56	3	Use fixed ap (TURBINE)
57	4	Accum ACF before reset (TRB)
58	4	Initial volume reset value(TRB)
59	2	Accum ACF rollover date (TRB)
60	5	Fb
61	5	Orifice diameter
62	5	Pipe diameter
63	5	Specific gravity
64	5	DP lo limit
65	5	DP hi limit
66	5	AP lo limit
67	5	AP hi limit
68	5	CO2 mole percent
69	5	N2 mole percent
70	5	AP lo calibration
71	5	AP mid calibration
72	5	AP hi calibration
73	5	DP lo calibration
74	5	DP mid calibration
75	5	DP hi calibration
76	5	DP zero cutoff
77	5	Temperature base
78	5	Pressure base
79	5	Fixed temperature
80	5	Temperature bias
81	5	Viscosity
82	5	Ratio of specific heats
83	5	Ft - gravity adjusted temp
84	5	Fp - gravity adjusted press
85	5	BTU/SCF
86	5	AP pressure marker
87	5	DP pressure marker
88	3	Contact on charger low (TRB)
89	3	Contact on acf low (TRB)

Event Code	Data Type	Description
90	3	Contact on acf hi (TRB)
91	3	Contact on ap lo (TRB)
92	3	Contact on ap hi (TRB)
93	3	Contact on remote sense (TRB)
94	3	Contact auto re-open (TRB)
95	3	Contact on vol set point (TRB)
96	5	ACF Lo Limit (TURBINE)
97	5	ACF Hi Limit (TURBINE)
98	5	Flow period (TURBINE)
99	5	Faux (TURBINE)
100	5	Faux
101	5	K (TURBINE)
102	5	Initial analys. OK?
103	5	VCF K0
104	5	VCF K1
105	5	VCF K2
106	1	Liquid type
107	1	Calculation units type
108	1	Z method
111	1	AGA calculation type
112	5	Fixed cd
115	5	Zba
116	9	Software revision change
117	1	Volume calculation period
118	8	Volume log period
119	5	H2S content
120	5	H20 content
121	5	Helium content
122	5	Methane content
123	5	Ethane content
124	5	Propane content
125	5	N-Butane content
126	5	I-Butane content
127	5	N-Bentane content
128	5	I-Pentane content
129	5	N-Hexane content
130	5	N-Heptane content
131	5	N-Octane content
132	5	N-Nonane content
133	5	N-Decane content
134	5	Oxygen content
135	5	Carbon Monoxide content
136	5	Orif coef of expansion
137	5	Pipe coef of expansion
138	5	barometric pressure
142	1	Characteristic type
143	3	Calculated or Fixed Cd in vol calc
144	5	Fixed Argon mole percent
145	5	Fixed hydrogen mole percent
146	4	Accumulated volume rollover
147	4	Event log full (CANADIAN EVENT)
148	4	Event log collected (CANADIAN)
149	1	Password mode, operator change

Event Code	Data Type	Description
150	3	Password mode, password enable
151	2	Password mode, password table
152	2	A/D converter could not be read
153	5	Ap mid lo calibration event
154	5	Ap mid hi calibration event
155	5	Dp mid lo calibration event
156	5	Dp mid hi calibration event
157	3	Use Faux
158	3	static pressure tap up/downstream
159	3	Use Y expansion factor
160	3	Use Fpv factor
161	3	Use Fw water vapor factor
162	5	Reset Log Period
164	3	Use Linear/Sqrt Averaging
165	3	Hold last read analog values (AP, DP, TF)
166	1	Maximum number of events log records
167	1	Maximum number of day period records
168	1	Maximum number of log period records
169	1	Size of local port communications buffer
170	1	Size of remote port communications buffer
171	8	Partition memory free space
172	3	Use fixed water content in wet gas calcs
173	5	Water content (LBS/MMSCF)
174	5	Water content bias

XIV. Radio Power Duty Cycling and Group Operation.

Duty cycling the power to the radio can significantly decrease the solar panel and battery requirements of a remote installation. Totalflow Modbus uses group addressing to control radio duty cycling. Using Modbus group addresses also removes the standard Modbus limit of 247 slave addresses per communications channel.

Totalflow Modbus group addressing and radio duty cycling work as follows:

Writing a group number into the Modbus group address register (3070) invokes Modbus group addressing. The FCU will listen for its standard Modbus slave address (0-247) only when the Modbus group address register (3070) matches the current group select register (3071) set by a previous broadcast.

The duty cycle is specified by setting the link establishment register (3020) to the desired cycle time (seconds). The FCU will power the radio once each duty cycle and listen for broadcasts. A duty cycle time of zero (0) means that the radio is always powered (used for group addressing without duty cycling).

When the remote unit is duty cycling the radio, the host must broadcast function code 6 (single register write command) to the current group select register (3071) continuously for the duty cycle interval. This forces remote units with matching Modbus group address registers (3070) to keep it's radio powered up and listen for subsequent commands (addressed to the standard slave address) until the group address register (3070) no longer matches the current group select register (3071).

The group returns to duty cycling when the host broadcasts a different group select. The current group select register is also reset (to 0) upon expiration of the maximum listen time specified in the listen timeout register (3072).

For example, the following ASCII mode broadcast command would set the current group select register to 1. As mentioned above, this command must be repeated for the configured duty cycle.

Broadcast :

BOF	Address	Function	Register	Data	LRC	EOF	Ready
:	00	06	0B FF	00 01	??	CR	LF

The remote device does not respond to the broadcast. It powers the radio and listens for Modbus commands directed to it's standard Modbus slave address. When the host is finished polling this group, it switches to the next goup by broadcasting a new group select address. If the host does not intend to switch to a new group, it should disable the current group by broadcasting a group select of zero (0).

XV. Communications Setup

The Totalflow Portable Calibration and Collection Unit (PCCU) or Laptop PCCU emulation software should be used to configure the FCU communications port. The following items can be set from the PCCU remote communications setup menu:

- Listen cycle: 1 second, 2 second, 4 second (Totalflow protocol only) (rdc=0,1,2)
- Radio Powerup Delay (Milliseconds) (rkd=ms)
- Transmit Key Delay (Milliseconds) (rxkd=mx)
- Transmit Unkey Delay (Milliseconds) (rxud=ms)
- Protocol: Totalflow, Modbus RTU, Modbus ASCII (rpp=1,5)
- Modbus Slave Address: 1-247 (mba=sa)
- BaudRate: 1200, 2400, 4800, 9600 (rbr=0,1,2,3,4)
- Number of Data Bits: 7 or 8 (rdb=7,8)
- Parity: None, Even, or Odd (rpr=0,1,2)
- Number of Stop Bits: 1 or 2 (rsb=1,2)
- Interface Module: RS-232, RS-485 (rxi=12,28)
- 16/32 Bit long/float registers (rp16=0,1)
- 16 bit long/float register with word swap (rp16=2)
- Zero base bias (rp16=64)

SOFTWARE CHANGE FORM

DATE: 10/12/01

BOARD(S) BASE NUMBER

TOTALFLOW PRODUCT DEVICE

MODBUS PROTOCOL, CB181, G.O., W/PI WELL TEST & MO ACCUM

REF DOCUMENTS:		**RAM/ROM JUMPERS**		
MODBUS:				
TEMPLATES:				
SETUP:				
PROM: 2015489-021				
APPLICATION REF GUIDE:				

RAM REQD:

DESCRIPTION	**FROM**			**TO**		
PART NUMBER				2100614-AI		
REV IN MEDIA				AA		
DATE IN MEDIA				10/12/01		
	CHECKSUM	**SIZE**	**PART #**	**CHECKSUM**	**SIZE**	**PART #**

PROM LABEL

EX FILES

README .MFG – LISTS FILES ON EX DISKETTE
2100614AIAA.DOC – WORD DOCUMENT

NEW FEATURES:

BUG FIXES:

RELEASE NOTES:

URGENT:___ INITIAL RELEASE:_X__ W/D PREVIOUS REL:__ REWORK PREVIOUS REL:___

FUNCTION	**NAME**	**DATE**
SOFTWARE ENGINEER	BRUCE SIEVERS	10/12/01
TESTED BY	BRUCE SIEVERS	10/12/01

SCALE	**SIZE**	**TYPE**	**DRAWING NO.**	**REV**	**SHEET**
NONE	**A**	**AI**			**OF**